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Natter

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(54) **TOUCH PROOF END CAP FOR A LEADING END OF A CONDUCTING CONNECTOR**

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H01R 13/447 (2006.01)

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CPC ***H01R 13/44*** (2013.01); ***H01R 13/447*** (2013.01)

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USPC 439/625, 133–135, 521, 131
See application file for complete search history.

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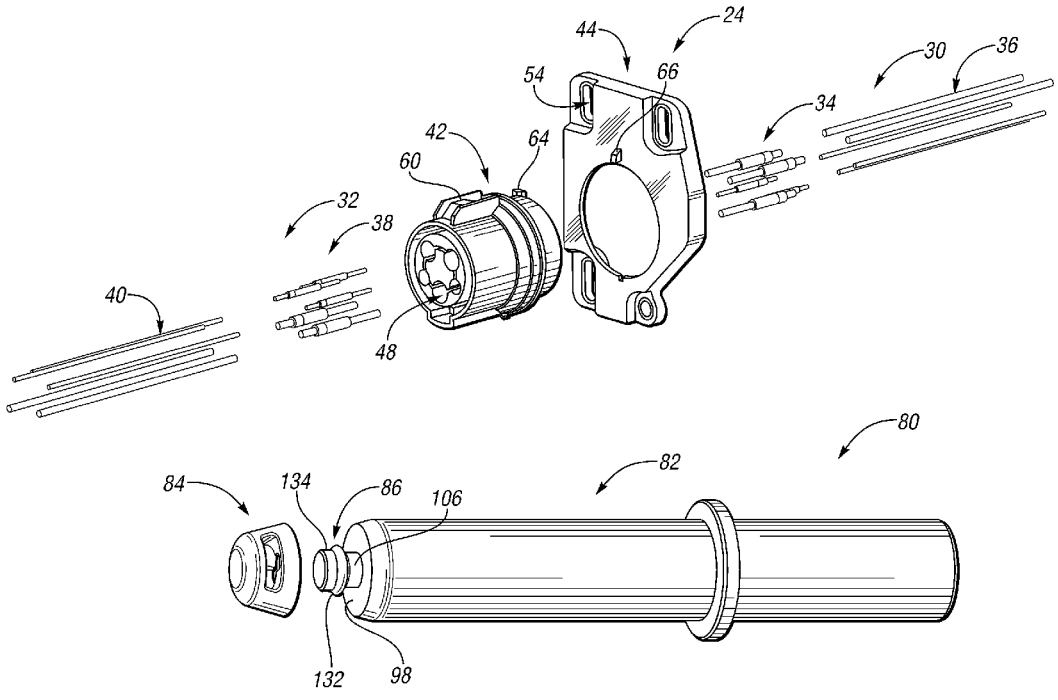
(57) **ABSTRACT**

A touch proof connector is contemplated. The connector may be comprised of a conducting body with a non-conducting end cap. The touch-proof connector may be included within a charging receptacle of a vehicle to facilitate establishing electrical connection with a connector assembly of a plug-in charging system. The non-conducting end cap may be configured to facilitate insulating a tip of the touch-proof connector from human contact.

20 Claims, 5 Drawing Sheets



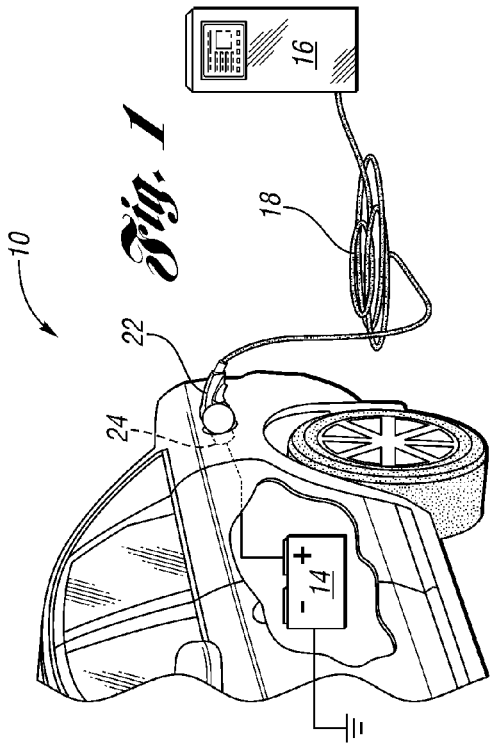


Fig. 1

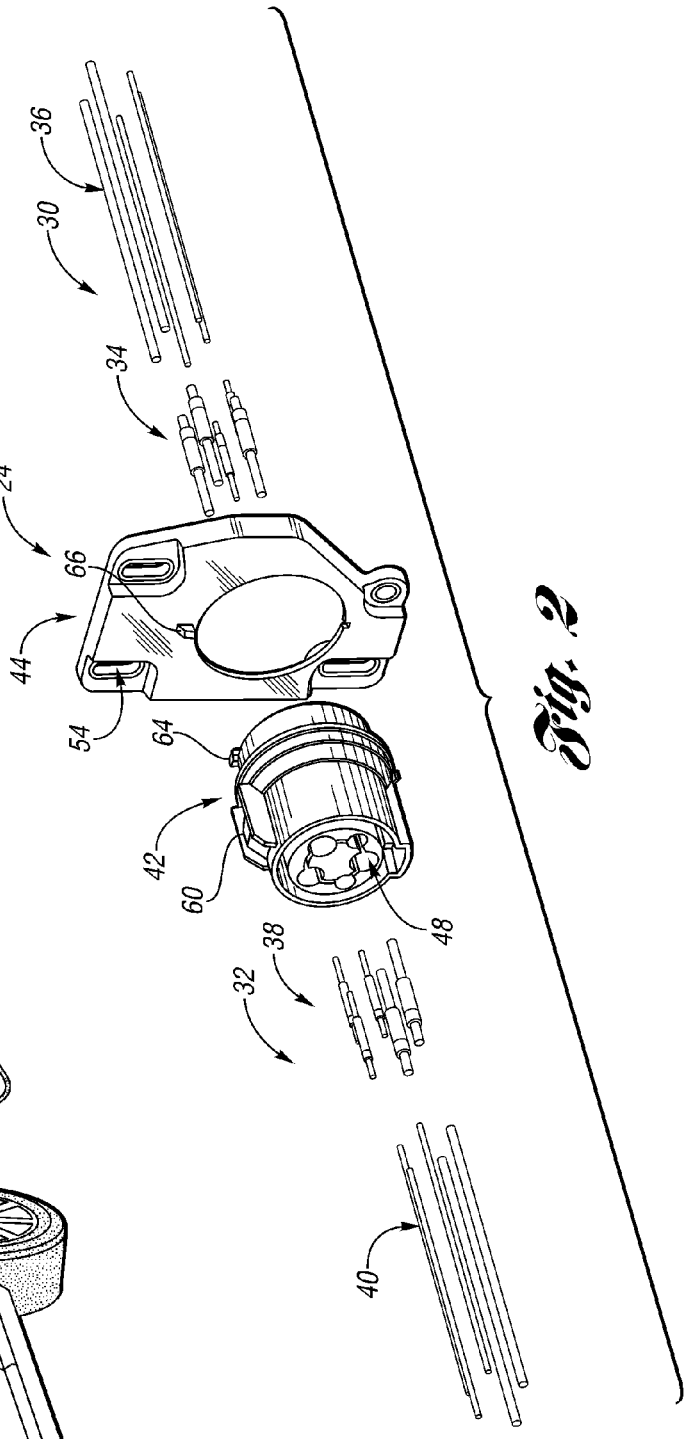


Fig. 2

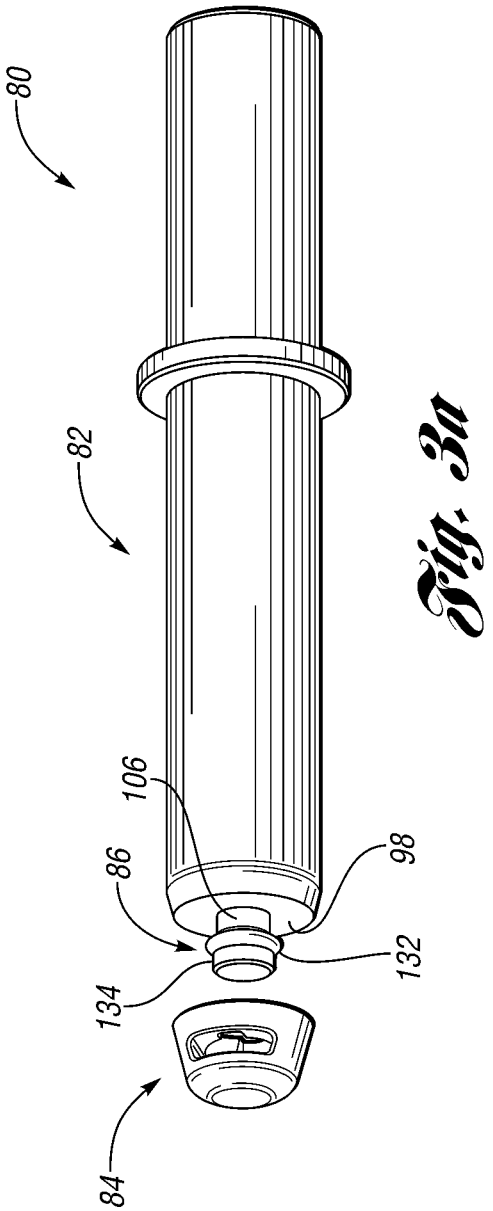


Fig. 3a

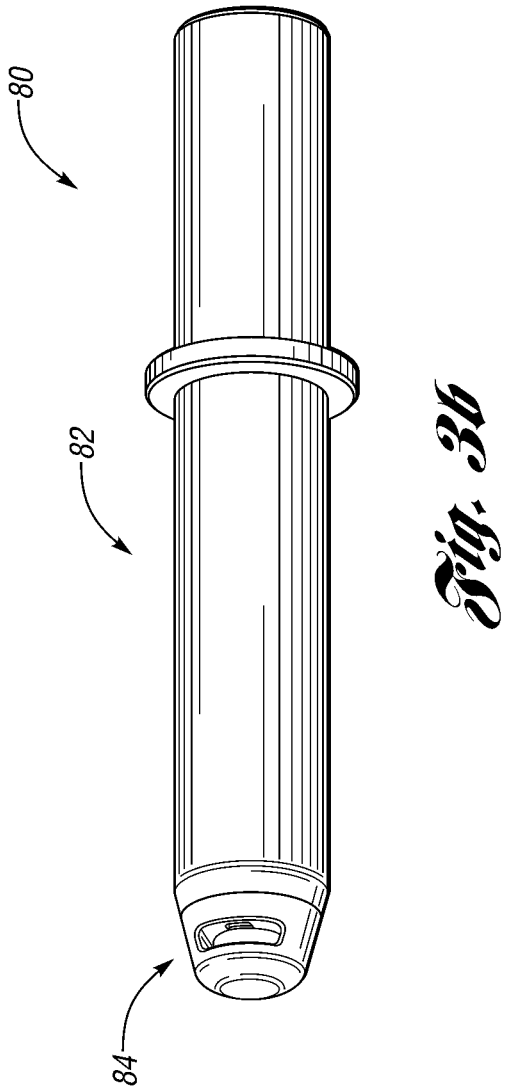


Fig. 3b

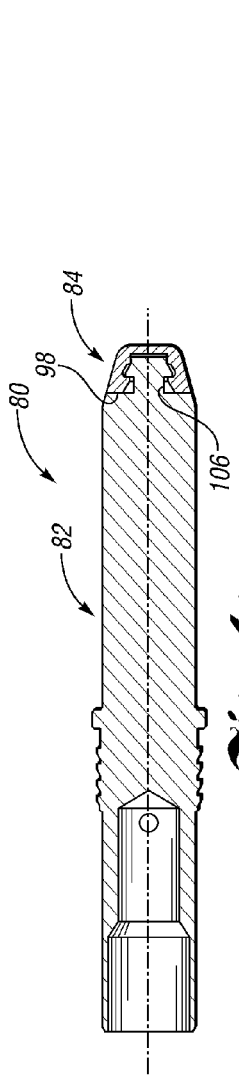


Fig. 4g

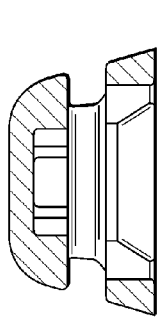


Fig. 4c

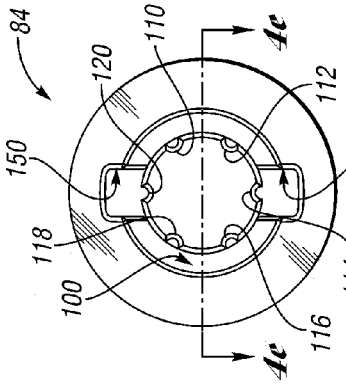


Fig. 4f

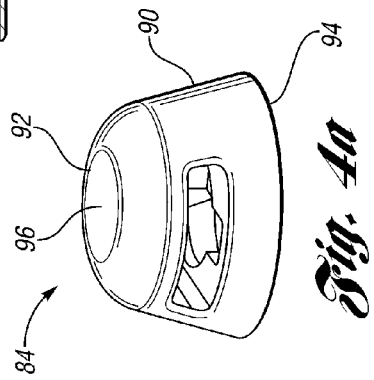


Fig. 4a

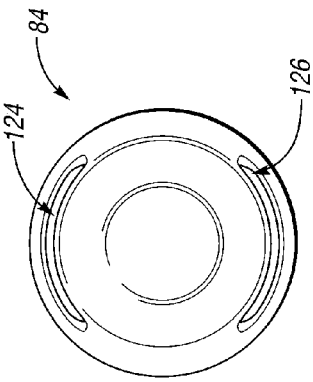


Fig. 4b

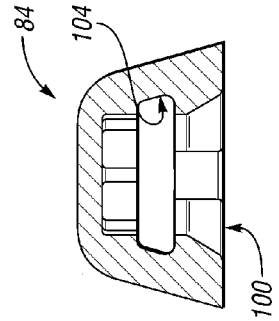


Fig. 4e

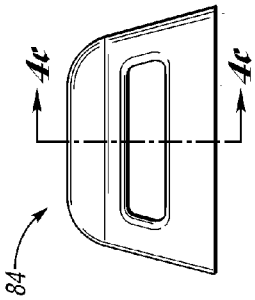


Fig. 4d

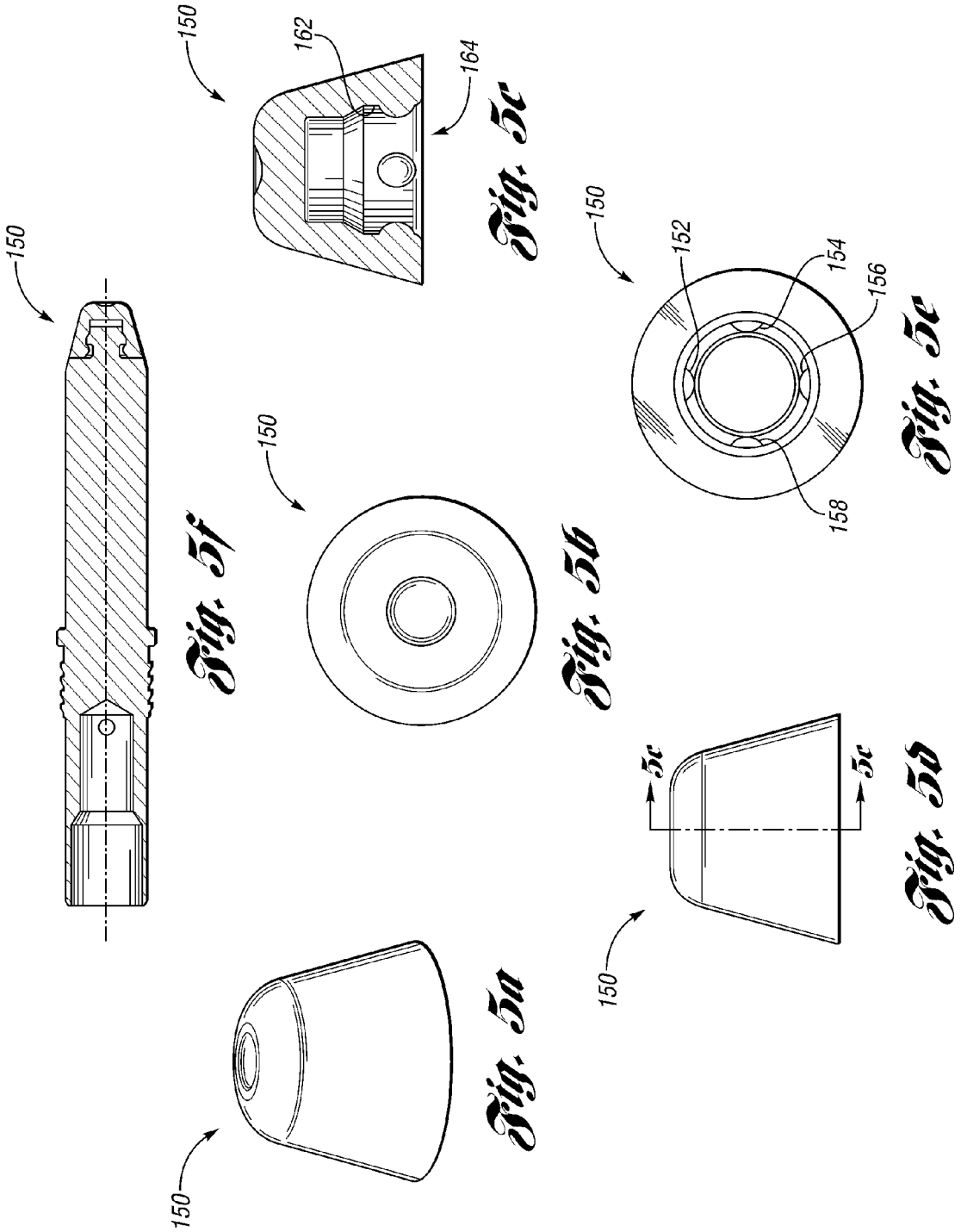


Fig. 5a

Fig. 5b

Fig. 5c

Fig. 5d

Fig. 5e

Fig. 5f

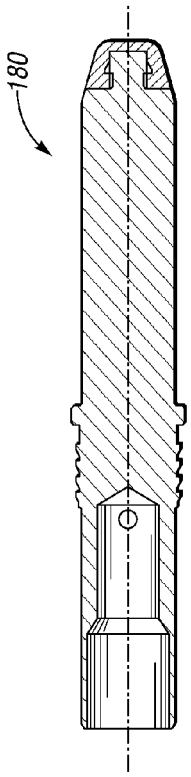


Fig. 6

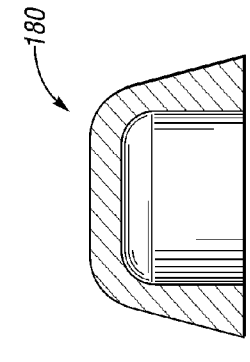


Fig. 6c

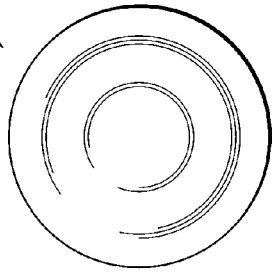


Fig. 6b

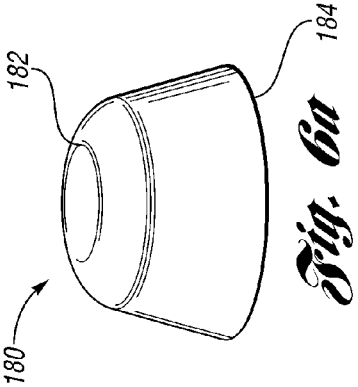


Fig. 6a

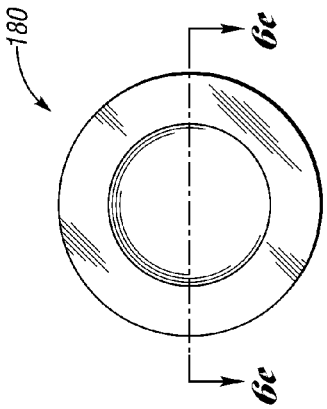


Fig. 6f

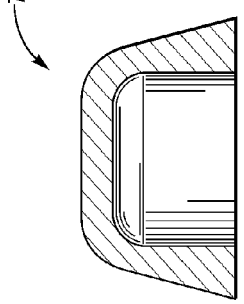


Fig. 6e

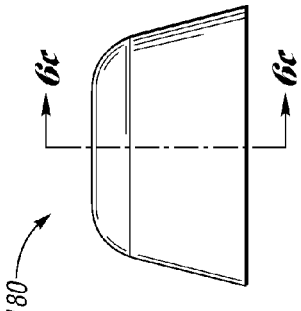


Fig. 6d

TOUCH PROOF END CAP FOR A LEADING END OF A CONDUCTING CONNECTOR

TECHNICAL FIELD

The present invention relates to electrical connectors, such as but not limited to electrical connectors of the type having an insulated tip connected to a conducting body portion.

BACKGROUND

Electrical connectors are used in a number of environments to facilitate electrically connecting to one or more components. Electrical connectors may be used within a receptacle to facilitate electrical interconnect with a device designed to be received within the receptacle. In the event the connector is exposed within the receptacle and a person were to inadvertently touch the connector while the connector is being powered, the person could establish an undesirable electrical connection with the connector. Accordingly, the present invention contemplates configuring the connector to limit the likelihood that a person or device could inadvertently touch the connector in a manner that would likely establish an electrical connection.

SUMMARY

One non-limiting aspect of the present invention contemplates a touch proof connector having an insulating end cap attached to a conducting body portion to prevent inadvertent touching of conducting body portion.

One non-limiting aspect of the present invention contemplates touch proof connector comprising: a conducting body portion a tip at one end; and a non-conducting end cap secured to the tip.

One non-limiting aspect of the present invention contemplates the end cap includes a leading end and a mating end, the mating end having an opening shaped to fit over the tip.

One non-limiting aspect of the present invention contemplates the mating end includes a relief shaped to snap-fit within a groove included within the tip.

One non-limiting aspect of the present invention contemplates the end cap includes a plurality of alignment protuberances outboard of the relief to facilitate centering the mating end relative to the tip.

One non-limiting aspect of the present invention contemplates the end cap includes at least one aperture transversely aligned with the opening to facilitate movement of the relief into the groove.

One non-limiting aspect of the present invention contemplates the tip includes a plurality of barbs shaped to engage the opening within the end cap.

One non-limiting aspect of the present invention contemplates the body portion includes a recessed end and a non-recessed end, the non-recessed end being shaped to have the tip.

One non-limiting aspect of the present invention contemplates a leading end of an exterior portion of the end cap tapers outwardly to a mating end, the mating end engaging a face of the body portion included rearward of the tip.

One non-limiting aspect of the present invention contemplates an outer diameter of the mating end is approximately equal to an outer diameter of the body portion proximate the mating end so as to provide a flush exterior surface at a boundary between the end cap and the body portion.

One non-limiting aspect of the present invention contemplates the end cap is overmolded to the tip.

One non-limiting aspect of the present invention contemplates end cap for use with a conducting connector comprising: a non-conducting body portion having a leading end and a mating end, the mating end being configured to engage a tip of the connector; and an opening within the mating end shaped to securely engage at least one groove included within the tip of the connector.

One non-limiting aspect of the present invention contemplates the mating end includes a relief shaped to snap-fit within at least one of the at least one groove included within the tip.

One non-limiting aspect of the present invention contemplates the end cap includes a plurality of alignment protuberances snap-fit within at least one of the at least one groove included within the tip.

One non-limiting aspect of the present invention contemplates the end cap includes at least one aperture transversely aligned with the opening to facilitate movement of the over the tip.

One non-limiting aspect of the present invention contemplates the opening is cylindrically shaped throughout.

One non-limiting aspect of the present invention contemplates charging receptacle for use within a vehicle to receive a connector assembly of a plug-in charging system, the charging receptacle comprising: a pin-shaped connector shaped to mate with a female connector included within the connector assembly; and a non-conducting end cap secured to the pin-shaped connector.

One non-limiting aspect of the present invention contemplates the end cap includes a leading end and a mating end, the leading end being closed and the mating end having an opening shaped to fit over the pin-shaped connector.

One non-limiting aspect of the present invention contemplates wherein the mating end includes a relief shaped to snap-fit within a groove of the pin-shaped connector.

One non-limiting aspect of the present invention contemplates wherein the end cap includes a plurality of alignment protuberances outboard of the relief.

One non-limiting aspect of the present invention contemplates wherein the end cap includes at least one aperture transversely aligned with the opening.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is pointed out with particularity in the appended claims. However, other features of the present invention will become more apparent and the present invention will be best understood by referring to the following detailed description in conjunction with the accompany drawings in which:

FIG. **1** illustrates a vehicle charging system as contemplated by one non-limiting aspect of the present invention.

FIG. **2** illustrates a charging receptacle as contemplated by one non-limiting aspect of the present invention.

FIGS. **3***a*-**3***b* illustrate a touch proof connector as contemplated by one non-limiting aspect of the present invention.

FIGS. **4***a*-**4***f* illustrate an end cap as contemplated by one un-limiting aspect of the present invention.

FIGS. **5***a*-**5***f* illustrate an end cap as contemplated by one non-limiting aspect of the present invention.

FIGS. **6***a*-**6***f* illustrate an end cap as contemplated by one non-limiting aspect of the present invention.

DETAILED DESCRIPTION

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the

disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. The figures are not necessarily to scale; some features may be exaggerated or minimized to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a representative basis for teaching one skilled in the art to variously employ the present invention.

FIG. **1** illustrates a charging system **10** operable to facilitate charging a vehicle charging system **14** with energy provided from a wall outlet or charging station **16** as contemplated by one non-limiting aspect of the present invention. The system may include a cordset **18** having plurality of conducting wires and/or other conducting elements to facilitate delivering current between the charging station **16** and the vehicle charging system **14**. One end of the cordset **18** may include a connector assembly **22** configured to be received within a charging receptacle **24** associated with the vehicle charging system. The connector assembly **22** may be of the type described in U.S. Pat. No. 7,878,866, the disclosure of which is hereby incorporated by reference in its entirety by reference.

The charging receptacle **24** may be configured to facilitate establishment of an electrical connection between a plurality of electrically conducting elements of the vehicle charging system **14** and the charging station **16**. The charging receptacle **24** may facilitate the desired electrical connection by providing interconnecting conducting elements and/or by guiding the vehicle charging system and cordset conducting elements into a mating arrangement with each other. The charging receptacle **24** may be configured to support a multiple pin or port connection methodology for facilitating electrically interconnecting the vehicle charging system and cordset conducting elements, including but not limited to that specified in Society of Automotive Engineer (SAE) J1772 and International Electrotechnical Commission (IEC) 51851.

FIG. **2** illustrates the charging receptacle **24** as contemplated by one non-limiting aspect of the present invention. The illustrated charging receptacle **24** may be configured to facilitate electrically interconnecting vehicle charging system conducting elements **30** with cordset **18** connecting conducting elements **32** by guiding the elements into engagement with each other. The vehicle charging system **14** is shown as having the conducting elements **30** terminating an arrangement of touch proof, pin-shaped connectors **34**. The touch proof connectors may be connected to five corresponding conducting wires **36** that lead to related features of the vehicle charging system **14** or to other vehicle subsystems. The cordset conducting elements **32** are shown as being configured as five open-ended terminals **38** being connected at one end to five conducting wires **40** of the cordset **18**.

The charging receptacle **24** includes a barrel **42** and a base **44**. Each may be comprised of plastic or non-plastic parts formed in a molding operation, such as by injection molding. The barrel **42** may include a plurality of through-hole openings **48** shaped to guide the cordset terminals **38** relative to the corresponding vehicle charging system connectors **34**. The base **44** may include an opening **50** for receiving the barrel **42**. The base **44** may include a plurality of fastener openings **54** through which fasteners may be received to facilitate mounting the charger receptacle **24** to the vehicle charging system **14** or some other portion of the vehicle **12**. Optionally, the barrel **42** may not include any features (e.g., fastener openings) for direct mounting to the vehicle. The barrel **42** may include a locking element **60** operable with a latch or other locking feature (not shown) on the cordset **18** to secure the cordset **18** to the charging receptacle **24** in a removable manner.

The barrel **42** may include a first alignment feature **64** that is to be aligned with a second alignment feature **66** on the base **44**. The first and second alignment features **64**, **66** may be tabs (as shown) or other protrusions and/or optically apparent features (bar code, target, etc.). The first alignment feature **64** is shown to be on an outer cylindrical portion of the barrel **42** and the second alignment feature **66** is shown to be proximate the opening **50** in the base **44** used to receive the barrel **42**. The proper alignment of the alignment features **64**, **66** may be checked to insure the barrel **42** is properly positioned within the base **44** and/or relative to the fastener openings **54**. The ability to maintain tight dimensional values between the barrel **42** and base **44**, e.g., through the proper rotational alignment of the alignment features **64**, **66**, can be helpful in ameliorating wear and tear on the conducting elements **30**, **32** when the conducting elements **30**, **32** are repeatedly engaged and disengaged from each other.

FIGS. **3***a*-**3***b* illustrate a touch proof connector **80** as contemplated by one non-limiting aspect of the present invention. The connector **80** may be configured for use as one of the connectors **34** included within the charging receptacle **24**. The connector **80** may include an electrically conducting body portion **82** and a non-conducting end cap **84**. The body portion **82** may be comprised of a conducting material and formed at one non-recessed end with a tip **86**. Optionally, the other end may be recessed to include an opening (not shown) shaped to receive the conducting wires. FIG. **3***a* illustrates the connector **80** prior to attachment of the end cap **84** to the tip **86**. FIG. **3***b* illustrates the connector **80** after attachment of the end cap **84** to the tip **86**. Once the end cap **84** is attached, the connector **80** becomes touch proof insofar as a person or other device is unlikely to inadvertently touch the tip **86** of the conductor **82** in a manner that is likely to establish an electrical connection to one of the conducting wires **36**.

FIGS. **4***a*-**4***f* illustrate the end cap **84** shown in FIGS. **3***a*-**3***b* in more detail. The end cap **84** may be comprised of any non-conducting material, such as but not limited to a plastic or rubber. In addition to the benefit of insulating the tip **86** of the conducting body **82**, the non-conducting material composition of the end cap **84** may also be selected to facilitate insertion of the connector **80** into a receiving device, such as by providing a low friction surface or a specially shaped surface (e.g., the conducting portion **82** is shown as a turned component such that in some configurations it may be more cost-effective to add a particular shape to the tip **86** using the end cap **84** instead of engaging in an expensive turning operation or the like). Of course, while the end cap **84** is described as being non-conducting, the present invention also contemplates the end cap **84** being comprised of a conducting material in the event it may not be desirable to insulate the tip **86**, such as in the event the end cap **84** is used to facilitate insertion operations where it inadvertent touching of the connector is not a concern.

An exterior portion **90** of the end cap **84** is shown to taper outwardly from a leading end **92** to a mating end **94**. While the exterior portion **90** may include other shapes, the illustrated taper is believed to be beneficial in facilitating insertion within a female shaped terminal, such as the terminals included in the connector assembly desired above. The leading end **92** is shown to be closed in that it is solidly formed of the material comprising the end cap **84**. Optionally, an indent or flattened portion **96** may be included in the leading end **92** to limit a length of the end cap **84** and/or to provide a blunt surface. The mating end **94** corresponds with a portion of the

end cap **84** that engages or presses against a face **98** included on the body portion **82** (see FIGS. **3***a*-**3***b*). The mating end **94** may include an opening **100** through which the tip **86** can be inserted. The opening **100** is shown to be tapered inboard of the mating end **94** to generate a relief **104**. The relief **104** may be sized to rest within a corresponding groove **106** within the tip **84**, such as but not limited to resting in an interlocking manner so as to generate a snap-fit. The snap-fit may provide a sufficient amount of force to securely retain the end cap **84** to the tip **86**.

To facilitate centering the end cap **84** relative to the tip **86**, the opening may include a plurality of protuberances **110**, **112**, **114**, **116**, **118**, **120** outboard of the relief **104**. The protuberances **110**, **112**, **114**, **116**, **118**, **120** may extend inwardly relative to the opening **100** to generate an interference fit with the tip **86**. The protuberances **110**, **112**, **114**, **116**, **118**, **120** may be equally distantly spaced around the perimeter of the opening **100** and sized so as to facilitate centering the end cap **84** without overly increasing a force required to position the end cap **84** over the tip **86**.

During the process of inserting the end cap **84** over the tip **86**, the end cap **84** may flex slightly outwardly as the tip travels longitudinally through the opening **100** to position the relief **104** over the groove **106**. The end cap **84** may include apertures **124**, **126** transversely positioned relative to the opening **100** and/or channels **128**, **130** within the mating end **94** in order to further facilitate flexing of the end cap **84** during the insertion process. Depending on the material composition and wall thicknesses of the end cap **84**, the size and shape of the apertures **124**, **126** and/or channels **128**, **130** may be adjusted so as to provide a sufficient flexing during insertion to permit the relief **104** to securely nest within the groove **106** without damaging structural integrity.

As shown in FIG. **3***a*, the tip **86** may include a tapered edge **132** leading to the groove **106**. The tapered edge **132** may be used to facilitate travel of the relief **104** into the groove **106** in a manner that helps ameliorate stresses placed on the end cap **84** while also enhancing a depth of the groove **106**. Optionally, rather than having a cylindrical portion **134** leading into the tapered edge **132**, the tapered edge **132** may be eliminated to provide a flat or smooth insertion surface to the groove **106**, such as in the event the material composition of the end cap **84** allows a sufficient amount of flex without overly increasing the insertion force. The thickness of the end cap **84** may also be selected so that, when the relief **104** is properly positioned within the groove **106**, the tapered edge **132** is not easily accessible through one of the transverse apertures **124**, **126**. This may be helpful in limiting the likelihood that the tip **86** is inadvertently touched through one of the transverse apertures **124**, **126**.

FIGS. **5***a*-**5***f* illustrate an end cap **150** as contemplated by one non-limiting aspect of the present invention. The end cap **150** may be may be similarly configured as the end cap **84** shown in FIGS. **4***a*-**4***f* in that it may be comprised of a non-conducting material that generates a snap-fit with the groove **106**. Rather than having an opening tapered to generate the snap-fit, the end cap **150** may include a plurality of protuberances **152**, **154**, **156**, **158**. The protuberances **152**, **154**, **156**, **158**, in addition to facilitating centering of the end cap **150**, may be sized and shape to generate a relief **162** into which the groove **106** sits. The protuberances **152**, **154**, **156**, **158** may be equally spaced around a perimeter of an opening **164** through which the tip **86** extends. Four protuberances **152**, **154**, **156**, **158** are illustrated as being included to facilitate securing the end cap **150**, however, the present invention fully contemplates use of more or less protuberances **152**, **154**, **156**, **158**. Because the protuberances **152**, **154**, **156**, **158** do not form an uninterrupted surface entirely around the perimeter of opening **164**, less surface area of the end cap **150** engages the tapered edge **132** of the tip **86** when inserting, which may be helpful ameliorating insertion forces, particularly when size constraints or material characteristics require a smaller end cap **150** or a larger groove **106**. Optionally, due to the use of the protuberances **152**, **154**, **156**, **158**, the end cap **150** may be formed without the need for transverse apertures.

FIGS. **6***a*-**6***f* illustrate an end cap **180** as contemplated by one non-limiting aspect of the present invention. The end cap **180** may be similarly configured to the end caps **86**, **150** described above in that it may be comprised of a non-conducting material operable to insulate an end of the conducting body portion **82**. The end cap **180** may include a closed leading **182** and in an open mating end **184**. The mating end **184** may include an opening **186** through which the tip **86** extends. The opening **186** is shown to include a uniform width/diameter throughout. The width may be selected to interfere with barbs (not shown) formed within the tip **86**. The barbs may be similar to the groove **106** shown above and/or it may be formed by providing an undercut at a rearward portion of the tapered edge **132** such that when the end cap **180** is inserted over the tip **86**, the undercut portion tends to grab or penetrate the end cap **180** to prevent removal. Optionally, multiple grooves and/or undercuts may be included within tip to further facilitate retaining the end cap.

The present invention predominately describes the end caps **84**, **150**, **180** as being generally radially shaped and the opening/protuberances included therein being positioned radially around a generally cylindrical opening. The present invention, however, fully contemplates its use and application with any type of conducting body such that the end cap **84**, **150**, **180** need not necessarily be of a generally radial shape. The end cap **84**, **150**, **180** may be shaped and sized differently from the illustrations provided herein in order to facilitate insulating a tip **86** or other portion of a conducting body **102** having a non-radial shape. The present invention also contemplates attaching the end cap **84**, **150**, **180** to the tip **86** of the conducting body portion **82** and with other means other than those associated with inserting the end cap **84**, **150**, **180** over the tip **86** in order to generate a snap-fit, such as by molding the end cap **84**, **150**, **180** directly to the conducting body portion **82**. This overmolding of the end cap **84**, **150**, **180** may be beneficial securing the end cap **84**, **150**, **180** to a tip **86** without having to specially shape the end cap **84**, **150**, **180** or the tip **86**, e.g., without having to machine a groove within the tip.

While exemplary embodiments are described above, it is not intended that these embodiments describe all possible forms of the invention. Rather, the words used in the specification are words of description rather than limitation, and it is understood that various changes may be made without departing from the spirit and scope of the invention. Additionally, the features of various implementing embodiments may be combined to form further embodiments of the invention.

What is claimed is:

1. An electrical connector comprising:

a conductive body portion with an exposed exterior having a tip at one end; and

a non-conductive end cap secured to the tip extending beyond a leading end of the conductive body portion to reduce inadvertent conductive contact at the tip, thereby limiting conductive contact to the exposed exterior of the conductive body portion.

2. The connector of claim **1** wherein the end cap includes a leading end and a mating end, the mating end having an opening shaped to fit over the tip.

3. The connector of claim 2 wherein the mating end includes a relief shaped to snap-fit within a groove included within the tip.

4. The connector of claim 3 wherein the end cap includes a plurality of alignment protuberances outboard of the relief to facilitate centering the mating end relative to the tip.

5. The connector of claim 3 wherein the end cap includes at least one aperture transversely aligned with the opening to facilitate movement of the relief into the groove.

6. The connector of claim 2 wherein the tip includes a plurality of barbs shaped to engage the opening within the end cap.

7. The connector of claim 2 wherein the body portion includes a recessed end and a non-recessed end, the non-recessed end being shaped to receive the tip.

8. The connector of claim 1 wherein the tip of the conductive body portion is oriented at a distal end of the conductive body portion; and

wherein a leading end of an exterior portion of the end cap tapers outwardly to a mating end, the mating end engaging a face of the body portion adjacent to the tip.

9. The connector of claim 2 wherein an outer diameter of the mating end is approximately equal to an outer diameter of the body portion proximate the mating end so as to provide a flush exterior surface at a boundary between the end cap and the body portion.

10. The connector of claim 1 wherein the end cap is overmolded to the tip.

11. The connector of claim 2 wherein the leading end is tapered to facilitate insertion within a terminal.

12. The connector of claim 2 wherein the leading end of the end cap includes a flattened portion.

13. The connector of claim 12 wherein the flattened portion conceals the tip of the conductive body portion.

14. The connector of claim 4 wherein the plurality of alignment protuberances are spaced around a perimeter of the opening in the end cap.

15. An end cap for use with a conductive connector comprising:

a non-conductive body portion having a leading end and a mating end, the mating end being configured to engage a tip of the connector; and

wherein an opening within the mating end is shaped to securely engage at least one groove included within the tip of the connector; and

wherein the leading end conceals the conductive connector to prevent conductive contact at the leading end, thereby limiting conductive contact to an exposed exterior of the connector.

16. The end cap of claim 15 wherein the mating end includes a relief shaped to snap-fit within at least one of the at least one groove included within the tip.

17. The end cap of claim 15 wherein the end cap includes a plurality of alignment protuberances snap-fit within at least one of the at least one groove included within the tip.

18. The end cap of claim 15 wherein the end cap includes at least one aperture transversely aligned with the opening to facilitate movement over the tip.

19. The end cap of claim 15 wherein the opening is cylindrically shaped throughout.

20. A charging assembly for use with a vehicle, the charging assembly comprising:

a pin-shaped connector with a conductive exterior shaped to mate with a female connector included within a connector assembly;

a non-conductive end cap according to claim 15 engaging the tip of the connector; and

a connector assembly of a plug-in charging system, the connector assembly comprising a female connector shaped to receive the pin-shaped connector for conductive contact at the conductive exterior only.

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